

**IN THE CLAIMS:**

- 1 1. (Currently amended) A method for megasonic cleaning a substrate, comprising the  
2 steps of:
- 3 a) providing a container having ~~side walls~~ sidewalls on all sides of said  
4 container, wherein at least two of said sidewalls have said container having  
5 an overflow on at least two sides, said container having ~~an~~ a container  
6 inlet for flowing fluid into said container, said container inlet located below  
7 said overflows;
- 8 b) providing at least one from the group including a first megasonic transducer  
9 with a first active surface and a first array of megasonic transducers with a  
10 first array active surface for providing vibrational energy in said container;
- 11 c) disposing a substrate in said container within said sidewalls, below said  
12 overflow, and substantially parallel to and spaced a first spacing from at  
13 least one from the group including said first active surface and said first  
14 array active surface;
- 15 d) immersing the substrate in said fluid, flowing said fluid upwardly in said  
16 container from said container inlet, through said first spacing, and over said  
17 overflows;
- 18 ~~c) immersing the substrate in said fluid in said container, wherein said fluid~~  
19 ~~flows over said overflow, and~~
- 20 f e) applying energy to at least one from the group including said first  
21 megasonic transducer and said first array of megasonic transducers to  
22 provide vibration in said fluid and to clean the substrate wherein

837BUS-X

Page 2 of 17

09/819,578

- 3 transducer and said first array of megasonic transducers has a frequency of at least  
4 400 kilohertz.

837BUS-X

~~Page 3 of 17~~

09/819,578

23 substantially all vibration provided in said fluid is from at least one from the  
24 group including said first megasonic transducer, said first array of  
25 megasonic transducers, a transducer arranged parallel to said first active  
26 surface, and a transducer arranged parallel to said first array active surface.

1 2. (Currently amended) A method as recited in claim 1, further comprising ~~the step of~~  
2 providing relative motion between said substrate and said transducer ~~in a direction~~  
3 ~~substantially parallel to the substrate~~, while performing said fluid-flowing and  
4 energy-applying steps (d) and (f).

1 3. (previously presented) A method as recited in claim 1, wherein said substrate has a  
2 substrate surface area and at least one from the group including said first active  
3 surface and said first array active surface has an area at least equal to 40% of the  
4 substrate surface area.

1 4. (previously presented) A method as recited in claim 1, wherein the substrate has a  
2 maximum diameter and said first spacing is in a range from 1% to 80% of said  
3 maximum diameter.

1 5. (previously presented) A method as recited in claim 1, wherein said first spacing is in  
2 a range from 1 micrometer to 160 millimeters.

1 6. (previously presented) A method as recited in claim 1, wherein said megasonic  
2 energy applied to at least one from the group including said first megasonic  
3 transducer and said first array of megasonic transducers has a frequency of at least  
4 400 kilohertz.

- 1 7. (previously presented) A method as recited in claim 1, wherein said megasonic  
2 energy applied to at least one from the group including said first megasonic  
3 transducer and said first array of megasonic transducers has a maximum power of at  
4 least 400 watts.
- 1 8. (previously presented) A method as recited in claim 7, wherein said megasonic  
2 energy is applied to at least one from the group including said first megasonic  
3 transducer and said first array of megasonic transducers with 20% to 100% of said  
4 maximum power.
- 1 9. (previously presented) A method as recited in claim 1, wherein said first megasonic  
2 transducer has an area and a total input power and wherein said input power divided  
3 by said area is at least four watts per square centimeter.
- 1 10. (Currently amended) A method as recited in claim 1, wherein said flowing a said  
2 fluid ~~step (d)~~ upwardly in said container comprises flowing a said fluid through said  
3 first spacing at a fluid flow rate sufficient to carry particles away from the substrate  
4 before they redeposit on the substrate.
- 1 11. (Currently amended) A method as recited in claim 1, wherein said container has a  
2 volume and wherein said flowing a said fluid ~~step (d)~~ comprises flowing a said fluid  
3 through said first spacing at a rate to replace the said fluid in said volume in less than  
4 or equal to one minute.

1 12. (Currently amended) A method as recited in claim 1, further comprising ~~the step of~~  
2 providing at least one from the group including a second megasonic transducer with  
3 a second active surface and a second array of megasonic transducers with a second  
4 array active surface in said tank, wherein at least one from the group including said  
5 second active surface and said second array active surface faces at least one from the  
6 group including said first active surface and said first array active surface, and is  
7 substantially parallel to and spaced a second spacing from at least one from the group  
8 including said first active surface and said first array active surface.

1 13. (Currently amended) A method as recited in claim 12, ~~wherein in said providing step~~  
2 ~~(b) further comprising completely immersing in said fluid~~ at least one from the group  
3 including said first megasonic transducer and said first array of megasonic  
4 transducers and at least one from the group including said second megasonic  
5 transducer and said second array of megasonic transducers ~~are both completely~~  
6 ~~immersed in said fluid.~~

1 14. (Currently amended) A method as recited in claim 12, ~~wherein said disposing step (c)~~  
2 ~~comprises further comprising~~ disposing the substrate in the tank said container  
3 between at least one from the group including said first active surface and said first  
4 array active surface and at least one from the group including said second active  
5 surface and said second array active surface.

1 15. (Currently amended) A method as recited in claim 14, ~~wherein said flowing step (d)~~  
2 further ~~comprises comprising~~ flowing the said fluid through said second spacing.

1 16. (Currently amended) A method as recited in claim 15, ~~wherein said applying energy~~  
2 ~~step (f) further comprises comprising~~ applying energy to said second megasonic  
3 transducer.

1 17. (Currently amended) A method as recited in claim 12, wherein said transducers first  
2 megasonic transducer and said second megasonic transducer provide energy to clean  
3 both sides and edges of the substrate.

1 18. (previously presented) A method as recited in claim 1, wherein said fluid comprises  
2 one of deionized water, dilute RCA cleaning solution and dilute citric acid solution.

1 19. (Canceled)

1 20. (Canceled)

1 21. (Canceled)

2 22. (Currently amended) A method as recited in claim 1, ~~wherein in said providing step~~  
3 ~~(b) further comprising said first transducer is completely immersed immersing said~~  
4 first transducer in said fluid.

1 23. (currently amended) A method for megasonic cleaning a single substrate, comprising  
2 the steps of:

- 3 a) providing a container comprising at least one from the group including a first  
4 megasonic transducer with a first active surface arranged in a horizontal plane  
5 and a first array of megasonic transducers with a first array active surface  
6 arranged in a horizontal plane, wherein at least one from the group including  
7 said first megasonic transducer and said first array of megasonic transducers is  
8 held in a fixed position, and wherein said container has ~~side walls~~ sidewalls on  
9 all sides, wherein at least two of said sidewalls have ~~said container having an~~  
10 ~~overflow on at least two sides~~, said container having ~~an~~ a container inlet for  
11 flowing fluid into said container, said container inlet located below said  
12 overflows;
- 13 b) disposing a single substrate in said container within said sidewalls, below said  
14 overflow, and substantially parallel to and spaced a spacing from said first active  
15 surface or said first array active surface;
- 16 c) immersing the single substrate in a fluid and flowing said fluid upwardly in said  
17 container from said container inlet, through said spacing, and ~~wherein said fluid~~  
18 ~~flows over said overflow~~ overflows; and
- 19 d) applying energy to said first megasonic transducer wherein substantially all  
20 vibration provided in said fluid is from at least one from the group including said  
21 first megasonic transducer, said first array of megasonic transducers, a  
22 transducer arranged parallel to said first active surface and a transducer arranged  
23 parallel to said first array active surface.

24-58. (Canceled)

837BUS-X

Page 7 of 17

09/819,578

1 59. (Currently Amended) A method for megasonic cleaning a single substrate,  
2 comprising the steps of:

3 (a) providing a container having ~~side walls~~ sidewalls on all sides of  
4 said container, wherein at least two of said sidewalls have said  
5 ~~container having~~ an overflow on at least two sides, said container  
6 having ~~an an~~ a container inlet for flowing fluid into said container,  
7 said container inlet located below said overflows;

8 (b) providing a first megasonic transducer with at least one from the  
9 group including a first active surface and a first array of megasonic  
10 transducers with a first array active surface, wherein at least one  
11 from the group including said first active surface and said first  
12 array active surface is arranged in a horizontal plane to provide  
13 megasonic vibration in said container;

14 (c) disposing a single substrate in said container within said sidewalls,  
15 below said overflow, facing, substantially parallel to, and spaced a  
16 first spacing from at least one from the group including said first  
17 active surface and said first array active surface, wherein said  
18 single substrate is within said sidewalls and below said ~~top edge~~  
19 overflows;

20 (d) providing a fluid in said container, immersing said single substrate  
21 in said fluid, and flowing said fluid upwardly in said container  
22 from said container inlet, through said first spacing, and wherein  
23 said fluid flows over said overflow overflows; and

24 (e) applying energy to said first megasonic transducer, wherein

25 substantially all vibration provided in said fluid is from at least one  
26 from the group including said first megasonic transducer, said first  
27 array of megasonic transducers, a transducer arranged parallel to  
28 said first active surface and a transducer arranged parallel to said  
29 first array active surface.

1 60. (previously presented) A method as recited in claim 59, wherein said single substrate  
2 has a substrate surface area and said first active surface or said first array active  
3 surface has an area at least equal to 40% of the substrate surface area.

1 61. (previously presented) A method as recited in claim 59, wherein said single substrate  
2 has a substrate surface and said first megasonic transducer or said first array of  
3 megasonic transducers is larger than said substrate surface.

1 62. (previously presented) A method as recited in claim 59, wherein the single substrate  
2 has a maximum diameter and said first spacing is in a range from 1% to 80% of said  
3 maximum diameter.

1 63. (previously presented) A method as recited in claim 59, wherein said first spacing is  
2 in a range from 1 micrometer to 160 millimeters.

1 64. (previously presented) A method as recited in claim 59, wherein said megasonic  
2 energy applied to said first megasonic transducer or said first array of megasonic  
3 transducers has a frequency of at least 400 kilohertz.

1 65. (previously presented) A method as recited in claim 59, wherein said megasonic  
2 energy applied to said first megasonic transducer or said first array of megasonic  
3 transducers has a maximum power of at least 400 watts.



- 1 66. (previously presented) A method as recited in claim 65, wherein said megasonic  
2 energy is applied to at least one from the group including said first megasonic  
3 transducer and said first array of megasonic transducers with 20% to 100% of said  
4 maximum power.
- 1 67. (previously presented) A method as recited in claim 59, wherein said first megasonic  
2 transducer has an area and a total input power and wherein said input power divided  
3 by said transducer area is at least four watts per square centimeter.
- 1 68. (Currently amended) A method as recited in claim 59, wherein said flowing a said  
2 fluid ~~step (d)~~ comprises flowing a said fluid through said ~~space between the single~~  
3 ~~substrate and said transducer~~ first spacing at a fluid flow rate sufficient to carry  
4 particles away from the single substrate before they redeposit on the single substrate.
- 1 69. (Currently amended) A method as recited in claim 59, wherein said container has a  
2 volume and wherein said flowing a fluid ~~step (d)~~ comprises flowing a fluid through  
3 said space between the single substrate and said transducer ~~first spacing~~ at a rate to  
4 replace the fluid in said volume in less than or equal to one minute.
- 1 70. (Currently amended) A method as recited in claim 59, further comprising ~~the step of~~  
2 providing at least one from the group including a second megasonic transducer with  
3 a second active surface and a second array of megasonic transducers with a second  
4 array active surface in said tank, wherein at least one from the group including said  
5 second active surface and said second array active surface faces at least one from the  
6 group including said first active surface and said first array active surface, and is  
7 substantially parallel to and spaced a second spacing from at least one from the group  
8 including said first active surface and said first array active surface.

1 71. (Currently amended) A method as recited in claim 70, wherein ~~in said providing step~~  
2 ~~(b) further comprising completely immersing in said fluid~~ at least one from the group  
3 including said first megasonic transducer and said first array of megasonic  
4 transducers and at least one from the group including said second megasonic  
5 transducer and said second array of megasonic transducers ~~are both completely~~  
6 ~~immersed in said fluid.~~

1 72. (Currently amended) A method as recited in claim 70, ~~wherein said disposing step (c)~~  
2 ~~comprises further comprising~~ disposing the single substrate ~~in the tank said container~~  
3 between at least one from the group including said first active surface and said first  
4 array active surface and at least one from the group including said second active  
5 surface and said second array active surface.

1 73. (Currently amended) A method as recited in claim 72, ~~wherein said flowing step (d)~~  
2 ~~further comprises comprising~~ flowing the said fluid through said second spacing.

1 74. (Currently amended) A method as recited in claim 73, ~~wherein said applying energy~~  
2 ~~step (f) further comprises comprising~~ applying energy to said second megasonic  
3 transducer.

1 75. (previously presented) A method as recited in claim 70, wherein said first megasonic  
2 transducer and said second megasonic transducer provide energy to clean both sides  
3 and edges of the single substrate.

1 76. (previously presented) A method as recited in claim 59, wherein said fluid comprises  
2 one of deionized water, dilute RCA cleaning solution and dilute citric acid solution.

1 77. (previously presented) A method as recited in claim 1, wherein at least one from the  
2 group including said first megasonic transducer and said first array of megasonic  
3 transducers is larger than said substrate.

1 78. (previously presented) A method as recited in claim 23, wherein said first megasonic  
2 transducer is larger than said single substrate.

1 79. Cancel

1 80. (Currently amended) The method as recited in claim 1, wherein ~~in said providing~~  
2 ~~step (b)~~ at least one from the group including said first active surface and said first  
3 array active surface is arranged in a horizontal plane.

1 81. (Withdrawn) The method as recited in claim 1, wherein ~~in said providing step (b)~~ at  
2 least one from the group including said first active surface and said first array active  
3 surface is arranged in a vertical plane.

82.-98 cancel

1 99. (New) A method as recited in claim 2, wherein said providing relative motion  
2 between said substrate and said transducer is in a direction substantially parallel to  
3 the substrate.